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(54) **LOCATION-BASED SERVICE GROUP DISCOVERY FOR SWITCHED DIGITAL VIDEO**

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(51) **Int. Cl.**

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H04N 21/426	(2011.01)
H04N 21/475	(2011.01)
H04N 21/258	(2011.01)
H04N 21/45	(2011.01)

(52) **U.S. Cl.**

CPC ***H04N 21/25808*** (2013.01); ***H04N 21/2668*** (2013.01); ***H04N 21/4516*** (2013.01)

(58) **Field of Classification Search**

None

See application file for complete search history.

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(57) **ABSTRACT**

A broadcast system and method that includes a video content network that connects a video server, a discovery server, a switched digital video service, a switched video manager, and a set-top box. The set-top box receives and stores an assigned location identifier, and receives a mapping from the discovery server, where the mapping includes records, each record associating a location identifier and a service group. The set-top box matches the assigned location identifier to the mapping to determine an assigned service group for the set-top box. The set-top box receives an address from the discovery server that identifies the switched video manager that is associated with the assigned service group. The set-top box operates in the broadcast system by communicating with the switched digital video service, and the switched video manager.

20 Claims, 2 Drawing Sheets

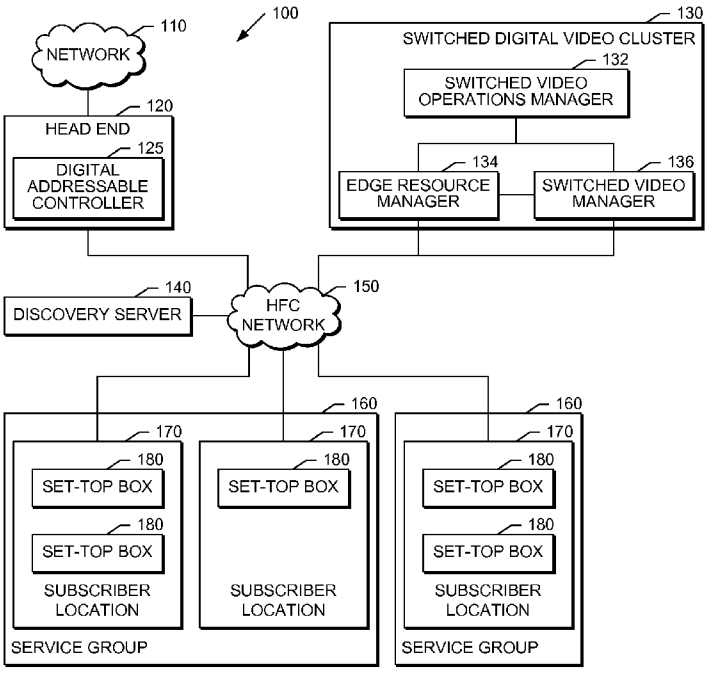


FIG. 1

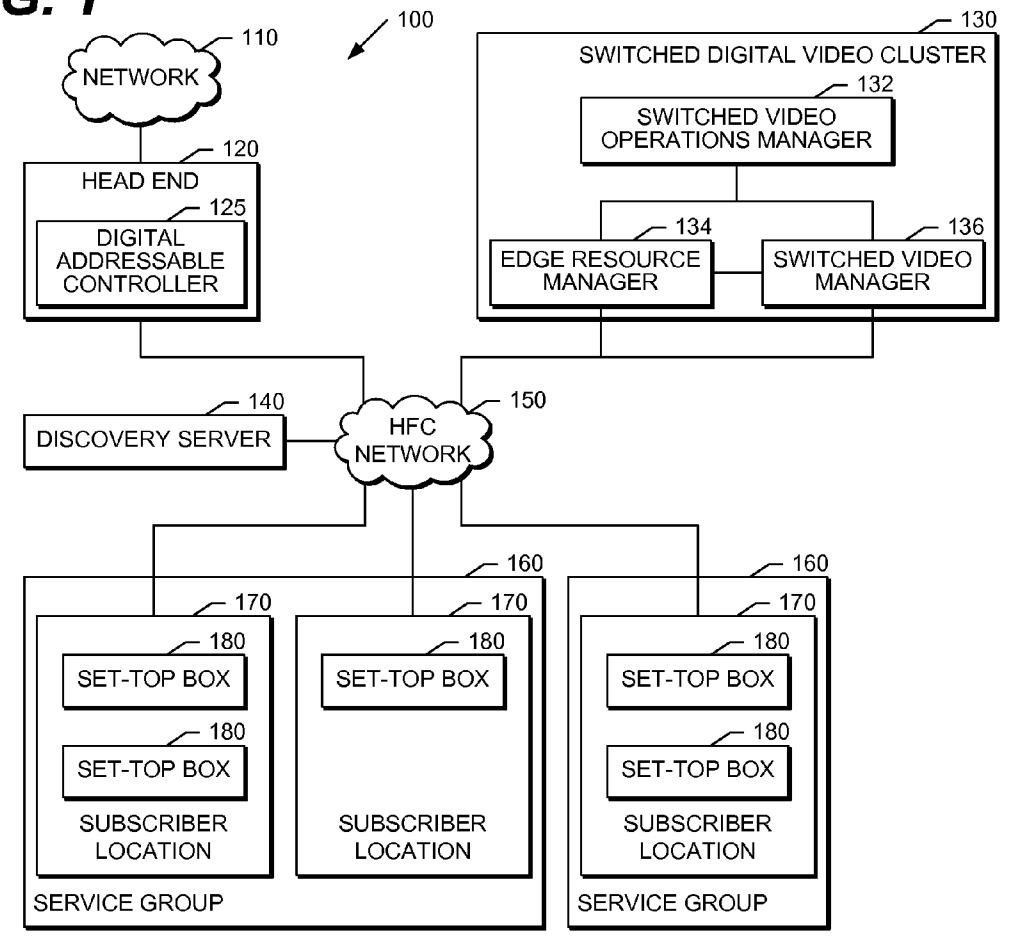

100
NETWORK
110
HEAD END
120
DIGITAL ADDRESSABLE CONTROLLER
125
SWITCHED DIGITAL VIDEO CLUSTER
130
SWITCHED VIDEO OPERATIONS MANAGER
132
EDGE RESOURCE MANAGER
134
SWITCHED VIDEO MANAGER
136
DISCOVERY SERVER
140
HFC NETWORK
150
160
170
SET-TOP BOX
180
SUBSCRIBER LOCATION
SERVICE GROUP

FIG. 2

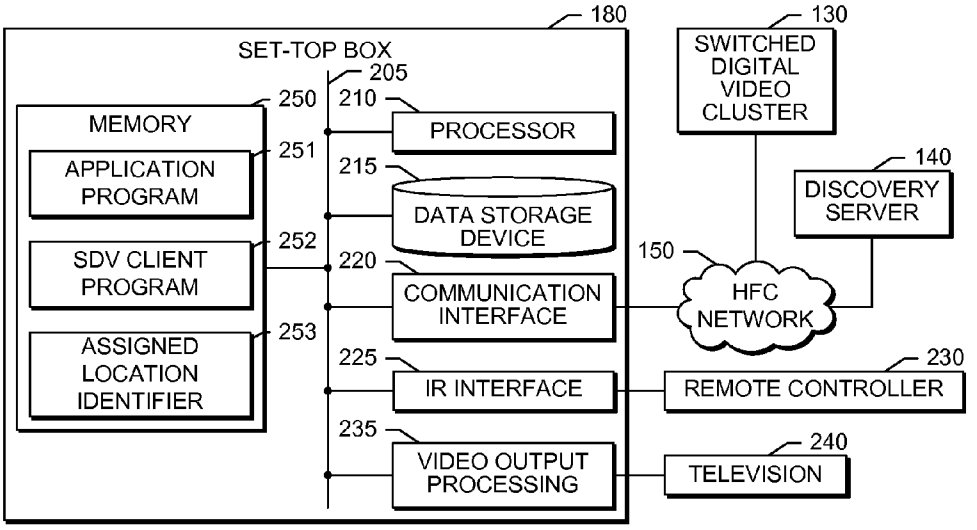
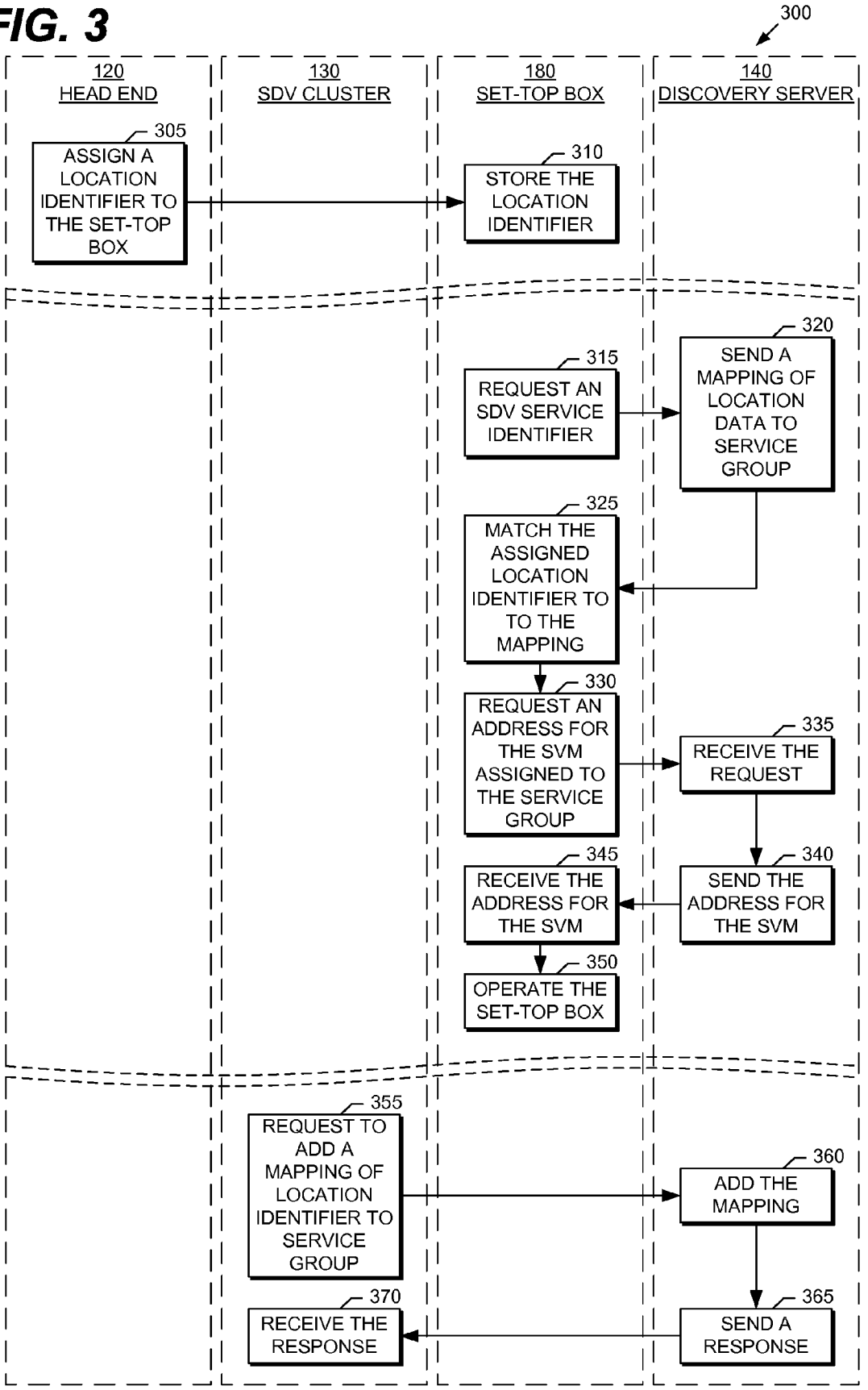

SET-TOP BOX
180
205
MEMORY
250
APPLICATION PROGRAM
251
SDV CLIENT PROGRAM
252
ASSIGNED LOCATION IDENTIFIER
253
PROCESSOR
210
DATA STORAGE DEVICE
215
COMMUNICATION INTERFACE
220
IR INTERFACE
225
VIDEO OUTPUT PROCESSING
235
SWITCHED DIGITAL VIDEO CLUSTER
130
DISCOVERY SERVER
140
HFC NETWORK
150
REMOTE CONTROLLER
230
TELEVISION
240

FIG. 3


300
120
HEAD END
130
SDV CLUSTER
180
SET-TOP BOX
140
DISCOVERY SERVER
305
ASSIGN A LOCATION IDENTIFIER TO THE SET-TOP BOX
310
STORE THE LOCATION IDENTIFIER
315
REQUEST AN SDV SERVICE IDENTIFIER
320
SEND A MAPPING OF LOCATION DATA TO SERVICE GROUP
325
MATCH THE ASSIGNED LOCATION IDENTIFIER TO TO THE MAPPING
330
REQUEST AN ADDRESS FOR THE SVM ASSIGNED TO THE SERVICE GROUP
335
RECEIVE THE REQUEST
340
SEND THE ADDRESS FOR THE SVM
345
RECEIVE THE ADDRESS FOR THE SVM
350
OPERATE THE SET-TOP BOX
355
REQUEST TO ADD A MAPPING OF LOCATION IDENTIFIER TO SERVICE GROUP
360
ADD THE MAPPING
365
SEND A RESPONSE
370
RECEIVE THE RESPONSE

LOCATION-BASED SERVICE GROUP DISCOVERY FOR SWITCHED DIGITAL VIDEO

BACKGROUND

A digital video broadcast system allows a multiple system operator (MSO) to deliver television programs and multimedia services to subscribers. The capacity, or bandwidth, of the system determines the programs and services that the MSO delivers. In legacy broadcast systems, the MSO sends all of the available programs and services to the subscriber's set-top box on a single cable. Thus, the only way to increase the programs and services available to subscribers in legacy broadcast systems is to increase the bandwidth.

Switched digital video is an improvement to the legacy broadcast systems that requires less bandwidth to deliver high-bandwidth digital services by allowing the MSO to send only the content requested by a service group, where each service group includes a set of set-top boxes with visibility to a common set of switched edge quadrature amplitude modulator (QAM) devices. To make this possible, the subscriber's set-top box communicates with a network side video server to request the program that the subscriber wants to watch in real time. The switched digital system responds by delivering the requested program to the subscriber's service group. Thus, the service group only receives the programs that subscribers in the service group are watching. In addition, the switched digital system collects data on the usage of the set-top boxes and reports this data to the MSO.

The assignment of service groups in existing switched digital video standards and protocols uses switched edge QAM devices to determine the service group. These standards do not define a message or method to autonomously segment the set-top box population into service groups, or send the group number to a set-top box client. Thus, in a legacy broadcast system, the issue that arises is the assignment of a service group to each set-top box when there are no switched edge QAM devices to distinguish the service groups, thereby allowing the set-top boxes to benefit from the advantages provided by a switched digital system.

There is a demand for a method and system to assign a service group to a set-top box where no switched edge QAM devices are visible to the in-band tuner. The presently disclosed invention satisfies this demand.

SUMMARY

Aspects of the present invention provide a broadcast system and method that includes a video content network that connects a video server, a discovery server, a switched digital video service, a switched video manager, and a set-top box. The set-top box receives and stores an assigned location identifier. The set-top box receives a mapping from the discovery server, where the mapping includes records, each record associating a location identifier and a service group. The set-top box matches the assigned location identifier to the mapping to determine an assigned service group for the set-top box. The set-top box receives an address from the discovery server that identifies the switched video manager that is associated with the assigned service group. The set-top box operates in the broadcast system by communicating with the switched digital video service, and the switched video manager.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a network diagram that illustrates one embodiment of the hardware components of a system that performs the present invention.

FIG. **2** is a block diagram that illustrates, in detail, one embodiment of the hardware components shown in FIG. **1**.

FIG. **3** is a message flow diagram that illustrates methods according to various embodiments of the present invention.

DETAILED DESCRIPTION

FIG. **1** is a network diagram that illustrates one embodiment of the hardware components of a system that performs the present invention. A broadcast system **100** includes a network **110** and a hybrid fiber-coaxial (HFC) network **150**. The HFC network **150** is a data and video content network that connects a gateway, such as a cable television head end **120**, to a switched digital video (SDV) cluster **130**, discovery server **140**, and subscriber location **170**. The broadband network **100** shown in FIG. **1** may include any number of interconnected networks **110**, head ends **120**, SDV clusters **130**, discovery servers **140**, HFC networks **150**, and subscriber locations **170**.

The head end **120**, in one embodiment, is a cable television master head end facility for receiving television signals for processing and distribution over a cable television system. The head end **120** provides the subscriber location **170** with a variety of services and/or connections, such as the connection to the network **110**. For example, the head end **120** may provide a connection to external services such as video servers, public switched telephone network voice, multimedia messages, and internet data. The head end **120** includes a user interface, such as a digital addressable controller (DAC) **125**, to allow an operator to configure the head end **120** components, and define channel map assignments and Federal Information Processing Standard (FIPS) codes.

The switched video operations manager (SVOM) **132**, edge resource manager (ERM) **134**, and switched video manager (SVM) **136** are the components comprising the SDV cluster **130** for the broadcast system **100**. The SVOM **132** is a computing device, including a processor and memory, which configures, monitors, and collects data from the ERM **134** and SVM **136** components. A cable operator uses the SVOM **132** to configure channels for SDV services, manage service group mappings, and administer the ERM **134**, SVM **136**, and edge QAM device (not shown) relationships. The SVOM **132** also collects usage and statistics information from set-top boxes **180**. This allows cable operators to centrally measure important information and generate reports on critical operational topics, including channel usage, set-top box **180** usage, channel change rates, and service group bandwidth utilization. The ERM **134** is a computing device, including a processor and memory, which manages the edge QAM device relationships in the head end **120** as established by the cable operator's policies. The ERM **134** receives requests for edge QAM devices, and selects the appropriate edge QAM device to satisfy the bandwidth requirements of the request. The SVM **136** is a computing device, including a processor and memory, which manages the SDV streams that are active at any given time, and directs each stream to the appropriate set-top box **180** that requested the stream. The SVM **136** also tracks the channels viewed by each set-top box **180**, and communicates with the ERM **134** to establish the requested channels.

The discovery server **140** is a searchable registry of components and services accessible in the broadcast system **100**. In one embodiment, the discovery server **140** is a Domain Name System (DNS) server that the set-top box **180** can query for a well known or advertised (e.g., carouseled) SDV service identifier. In another embodiment, the discovery server **140** is a ubiquitous DNS server such as BIND.

The subscriber location **170** includes a computing device, such as a set-top box **180**, to receive, decode and display data and video content, and provide access to the services and/or connections that the head end **120** provides. A service group **160** is an organization that includes a number of subscriber locations **170**, each subscriber location **170** including one or more set-top boxes **180**. A unique identifier associated with each service group **160**, subscriber location **170**, and/or set-top box **180** supports the functionality and advantages provided by the head end **120**, SDV cluster **130**, and discovery server **140**.

In one embodiment shown in FIG. **1**, the broadcast system **100** is a switched digital video (SDV) broadcast system. In the switched broadcast system **100**, the SDV cluster **130** manages a set of edge QAM devices (not shown) that the broadcast system **100** bind and unbind to particular services based on requests from the set-top boxes **180** at the subscriber locations **170**. The SDV cluster **130** monitors the requests that the set-top boxes **180** send to measure viewership. When a viewer decides to change the channel, the set-top box **180** sends a channel change message that the SVM **136** monitors. The SVM **136** parses the channel change message to obtain an identifier of the service group **160**, subscriber location **170**, and/or set-top box **180** that identifies the set of switched edge QAM devices visible to the set-top box **180**. Typically, a set-top box **180** assigns the identifier via an in-band carousel, or a message exchange with the SVM **136** known as auto-discovery. In a typical switched broadcast system **100**, the SDV cluster **130** uses the identifier to bind the requested channel to an edge QAM device visible to the service group.

In another embodiment shown in FIG. **1**, the broadcast system **100** is a legacy, non-switched, broadcast system. In the non-switched broadcast system **100**, since there is an excess of bandwidth, switched edge QAM devices (not shown) are not yet necessary. However, the SDV cluster **130** can still provide value to the subscribers in the non-switched broadcast system **100** because it can provide channel change statistics and reporting. In addition, when the non-switched broadcast system **100** combines the channel change data with an electronic program guide (EPG), the cable operator obtains a very accurate description of the viewership for every channel on the cable plant. In the non-switched broadcast system **100**, the SDV cluster **130** does not manage the edge QAM devices, but it still assigns and supports an identifier of the service group **160**, subscriber location **170**, and/or set-top box **180**. This allows the SDV cluster **130** to still use standard protocols (e.g., ISA and NGOD), while also maintaining a similar code base for both switched and non-switched deployments. In the non-switched broadcast system **100**, the identifier of the service group **160**, subscriber location **170**, and/or set-top box **180** has value to the cable operators, and third parties such as advertisers, because the SDV cluster **130** can generate reports based on the identifier. These reports are particularly valuable if the cable operators and third parties use the identifier to represent a designated market area (DMA), or other geographic area. The geographic boundaries of a service group in a switched broadcast system **100** depend on the reach of associated switched edge QAM devices, but the boundaries of interest to the cable operators and third parties will likely correspond to a narrower geographic region.

The network **110** shown in FIG. **1**, in one embodiment, is a public communication network or wide area network (WAN) that connects to the head end **120**. The present invention also contemplates the use of comparable network architectures. Comparable network architectures include the Public Switched Telephone Network (PSTN), a public packet-switched network carrying data and voice packets, a wireless network, and a private network. A wireless network includes a cellular network (e.g., a Time Division Multiple Access (TDMA), Code Division Multiple Access (CDMA), or Orthogonal Frequency Division Multiplexing (OFDM) network), a satellite network, and a wireless Local Area Network (LAN) (e.g., a wireless fidelity (Wi-Fi) network). A private network includes a LAN, a Personal Area Network (PAN) such as a Bluetooth network, a wireless LAN, a Virtual Private Network (VPN), an intranet, or an extranet. An intranet is a private communication network that provides an organization such as a corporation, with a secure means for trusted members of the organization to access the resources on the organization's network. In contrast, an extranet is a private communication network that provides an organization, such as a corporation, with a secure means for the organization to authorize non-members of the organization to access certain resources on the organization's network. The system also contemplates network architectures and protocols such as Ethernet, Token Ring, Systems Network Architecture, Internet Protocol, Transmission Control Protocol, User Datagram Protocol, Asynchronous Transfer Mode, and proprietary network protocols comparable to the Internet Protocol.

The HFC network **150** is a broadband network that combines optical fiber and coaxial cable, technology commonly employed globally by cable television operators since the early 1990s. The fiber optic network extends from the cable operators master head end, sometimes to regional head ends, and out to a neighborhood hubsite, and finally to a fiber optic node that serves anywhere from 25 to 2000 homes. The master head end will usually have satellite dishes for reception of distant video signals as well as IP aggregation routers. Some master head ends also house telephony equipment for providing telecommunications services to the community. The regional head ends receive the video signal from the master head end and add to it the Public, Educational and/or Governmental (PEG) channels as required by local franchising authorities or insert targeted advertising that would appeal to the region. The various services are encoded, modulated and up-converted onto RF carriers, combined onto a single electrical signal and inserted into a broadband optical transmitter. This optical transmitter converts the electrical signal to a downstream optically modulated signal that is sent to the nodes. Fiber optic cables connect the head end to optical nodes in a point-to-point or star topology, or in some cases, in a protected ring topology.

FIG. **2** is a block diagram that illustrates, in detail, one embodiment of the hardware components shown in FIG. **1**. In particular, FIG. **2** illustrates the hardware components and software comprising the set-top box **180** shown in FIG. **1**.

The set-top box **180**, in one embodiment, is a general-purpose computing device that performs the present invention. A bus **205** is a communication medium that connects a processor **210**, data storage device **215** (such as a Serial ATA (SATA) hard disk drive, optical drive, Small Computer System Interface (SCSI) disk, flash memory, or the like), communication interface **220**, infrared (IR) interface **225**, video output processing **235**, and memory **250** (such as Random Access Memory (RAM), Dynamic RAM (DRAM), non-volatile computer memory, flash memory, or the like). The communication interface **220** connects the set-top box **180** to the HFC network **150**. The IR interface **225** connects the set-top box **180** to a remote controller **230**. The video output processing **235** connects the set-top box **180** to a display device such as a television **240**, and sends the video content that the television **240** screen displays. In one embodiment,

the implementation of the set-top box **180** is an application-specific integrated circuit (ASIC).

The processor **210** performs the disclosed methods by executing the sequences of operational instructions that comprise each computer program resident in, or operative on, the memory **250**. The reader should understand that the memory **250** may include operating system, administrative, and database programs that support the programs disclosed in this application. In one embodiment, the configuration of the memory **250** of the set-top box **180** includes an application program **251**, SDV client program **252**, and assigned location identifier **253**. The application program **251** provides the viewer with access to basic functions, such as the display of a video content stream on the television **240**, and advanced functions, such as video-on-demand (VOD), interactive television, and other next-generation television application programs. The SDV client program **252** is a program that interfaces with the SDV cluster **130** and discovery server **140**. The SDV client program **252** enables the SDV cluster **130** and discovery server **140** to centrally measure important information and generate reports on critical operational topics, including channel usage, set-top box **180** usage, channel change rates, and service group bandwidth utilization. The assigned location identifier **253** is an identifier that associates the set-top box **180** to a location, such as a service group **160** or subscriber location **170**. The application program **251**, SDV client program **252**, and assigned location identifier **253** perform the methods of the present invention disclosed in detail in FIG. **3**. When the processor **210** performs the disclosed methods, it stores intermediate results in the memory **250** or data storage device **215**. In another embodiment, the memory **250** may swap these programs, or portions thereof, in and out of the memory **230** as needed, and thus may include fewer than all of these programs at any one time.

FIG. **3** is a flow diagram that illustrates a method according to one embodiment of the present invention. In particular, FIG. **3** illustrates the communication between the SDV cluster **130**, discovery server **140**, and the set-top box **180**.

The process **300** shown in FIG. **3**, with reference to FIG. **1** and FIG. **2**, begins with an operator at a head end **120** assigning a location identifier to the set-top box **180** (step **305**). In one embodiment, the operator uses the digital addressable controller **125** in the head end **120** to send the location identifier to the set-top box **180**. The set-top box **180** receives and stores the location identifier (step **310**). In one embodiment, the set-top box **180** stores the location identifier in the assigned location identifier **253** segment of the memory **250**. In one embodiment, the location identifier is a FIPS code, zip code, or Designated Market Area (DMA) code that associates the service group **160** or subscriber location **170** to a set-top box **180**. When the location identifier is a FIPS code, the location identifier is, for example, "042091".

After assigning the location identifier, the process **300** requests a well known or advertised (e.g., carouseled) SDV service identifier (step **315**). In one embodiment, the request is for a well known or advertised (e.g., carouseled) SDV service identifier. In another embodiment, the request is sent to a Domain Name System (DNS) as the discovery server **140**. In one exemplary DNS embodiment, the request is a standard DNS query for an SDV service identifier, where the record type is TXT, and the domain name is "svm.testdomain.com". After receiving the query, the discovery server **140** prepares a mapping of location identifiers to service groups **160** or subscriber locations **170**. In one embodiment, the mapping provides the set-top box **180** with a list of service groups based on location identifiers for every set-top box **180** in the broadcast system. In the exemplary DNS embodiment, the mapping is "042091=100", "042092=101", "042093=102", "042094=103", and "042095=104". In one embodiment, when the mapping includes more mappings than will fit in a single DNS message, the DNS server will set a bit in the DNS response message that indicates that more records are available. This will allow a virtually unlimited number of records in the response. The discovery server **140** sends the mapping in response to the query (step **320**). When the set-top box **180** receives the mapping, it matches the assigned location identifier **253** to the mapping (step **325**) to determine an identifier of the assigned service group **160** or subscriber location **170** for the set-top box **180**. In the exemplary DNS embodiment, the set-top box **180** obtains the associated assigned service group **160** as "100". The set-top box **180** uses the associated assigned service group **160** to send a second request to the discovery server **140** for an address of the SVM associated with the service group **160** (step **330**). In one embodiment, the address is internet protocol (IP) address. In the exemplary DNS embodiment, the second request is a standard DNS query for an IP address, where the record type is A, and the domain name is "sg100.svm.testdomain.com". The discovery server **140** receives the second request (step **335**), and sends the address for the SVM (step **340**). In the exemplary DNS embodiment, the reply is a DNS reply, where type is A, and the value is "10.0.0.1". The set-top box **180** receives the address for the SVM (step **345**), and uses the SVM address to operate the set-top box in an SDV environment (step **350**). In one embodiment, the operation of the set-top box **180** includes sending usage data to the switched digital video cluster **130**, where the usage data includes channel usage data, set-top box **180** usage data, channel change data, and bandwidth utilization data.

Before a set-top box **180** can successfully complete the discovery process, the process **300**, asynchronous to the service group **160** discovery, adds the correct mapping to the SDV cluster **130**, and the discovery server **140**. The SDV cluster **130** sends a request to add a mapping of location identifier to service group **160** or subscriber location **170** to the discovery server **140** (step **355**). The discovery server **140** receives the request and adds the mapping (step **360**). If the addition of the mapping is successful, the discovery server **140** sends a success response (step **365**) that the SDV cluster **130** receives (step **370**). In one embodiment, the SDV cluster **130** keeps the DNS discovery servers **140** up-to-date with service group **160** or subscriber location **170** mappings via Dynamic DNS (DDNS), which is supported today in ubiquitous DNS servers such as BIND. Furthermore, the use of DDNS alleviates the burden on operators to manually keep the DNS discovery server **140** in-sync with the configuration of the SDV cluster **130**. In one embodiment, the updates to the discovery server **140** are secure updates using the transaction signature.

Although the disclosed embodiments describe a fully functioning method and system for assigning a service group to a set-top box where no switched edge QAM devices are visible to the in-band tuner, the reader should understand that other equivalent embodiments exist. Since numerous modifications and variations will occur to those reviewing this disclosure, the method and system for assigning a service group to a set-top box where no switched edge QAM devices are visible to the in-band tuner is not limited to the exact construction and operation illustrated and disclosed. Accordingly, this disclosure intends all suitable modifications and equivalents to fall within the scope of the claims.

We claim:

1. A method, comprising:

receiving an assigned location identifier for a set-top box;

receiving a mapping from a discovery server, the mapping having at least one record, each record associating a location identifier and a service group;

matching, by a computer, the assigned location identifier to the mapping to determine an assigned service group for the set-top box;

receiving an address from the discovery server, the address identifying a switched video management server that is associated with the assigned service group; and

operating the set-top box in a broadcast system by communicating with the switched digital video service, and the switched video management server.

2. The method of claim 1, wherein the receiving of the assigned location identifier further comprises:

receiving a configuration request message that includes the assigned location identifier; and

storing the assigned location identifier in the set-top box,

wherein the assigned location identifier associates the set-top box with an assigned service group.

3. The method of claim 1, wherein the receiving of the mapping further comprises:

sending a first request to the discovery server, the first request including an identifier of a switched digital video service; and

receiving a first response from the discovery server, wherein the first response is to the first request, and includes the mapping.

4. The method of claim 3, wherein the identifier of the switched digital video service is well known or advertised.

5. The method of claim 1, wherein the matching of the assigned location identifier further comprises:

comparing the assigned location identifier to each location identifier in the mapping,

wherein the assigned service group is the service group associated with the location identifier that matches the assigned location identifier.

6. The method of claim 1, wherein the receiving of the address further comprises:

sending a second request to the discovery server, the second request including the assigned service group; and

receiving a second response from the discovery server, wherein the second response is to the second request, and includes the address.

7. The method of claim 1, wherein the operating of the set-top box further comprises:

sending at least one of channel usage data, set-top box usage data, channel change data, and bandwidth utilization data.

8. The method of claim 1, wherein the broadcast system includes the switched digital video service, the discovery server, and the switched video management server.

9. The method of claim 8, wherein the broadcast system is a switched digital video broadcast system.

10. The method of claim 8, wherein the broadcast system is a non-switched digital video broadcast system.

11. A broadcast system, comprising:

a video content network that connects a video server, a discovery server, a switched digital video service, and a switched video management server;

a computing device connected to the video content network and a video display device, the computing device comprising:

a memory device resident in the computing device; and

a processor disposed in communication with the memory device, the processor configured to:

receive an assigned location identifier for the computing device;

receive a mapping from the discovery server, the mapping having at least one record, each record associating a location identifier and a service group;

match the assigned location identifier to the mapping to determine an assigned service group for the computing device;

receive an address from the discovery server, the address identifying the switched video management server that is associated with the assigned service group; and

operate the computing device by communicating with the switched digital video service, and the switched video management server.

12. The broadcast system of claim 11, wherein to receive the assigned location identifier, the processor is further configured to:

receive a configuration request message that includes the assigned location identifier; and

store the assigned location identifier in the set-top box,

wherein the assigned location identifier associates the computing device with an assigned service group.

13. The broadcast system of claim 11, wherein to receive the mapping, the processor is further configured to:

send a first request to the discovery server, the first request including an identifier of the switched digital video service; and

receive a first response from the discovery server, wherein the first response is to the first request, and includes the mapping.

14. The broadcast system of claim 13, wherein the identifier of the switched digital video service is well known or advertised.

15. The broadcast system of claim 11, wherein to match the assigned location identifier, the processor is further configured to:

compare the assigned location identifier to each location identifier in the mapping,

wherein the assigned service group is the service group associated with the location identifier that matches the assigned location identifier.

16. The broadcast system of claim 11, wherein to receive the address, the processor is further configured to:

send a second request to the discovery server, the second request including the assigned service group; and

receive a second response from the discovery server, wherein the second response is to the second request, and includes the address.

17. The broadcast system of claim 11, wherein to operate the computing device, the processor is further configured to:

send at least one of channel usage data, set-top box usage data, channel change data, and bandwidth utilization data.

18. The broadcast system of claim 11, wherein the broadcast system is a switched digital video broadcast system.

19. The broadcast system of claim 11, wherein the broadcast system is a non-switched digital video broadcast system.

20. A non-transitory computer-readable medium, comprising computer-executable instructions that, when executed on a computing device, perform steps of:

receiving an assigned location identifier for a set-top box;

receiving a mapping from a discovery server, the mapping having at least one record, each record associating a location identifier and a service group;

matching the assigned location identifier to the mapping to determine an assigned service group for the set-top box;

receiving an address from the discovery server, the address identifying a switched video management server that is associated with the assigned service group; and

operating the set-top box in a broadcast system by communicating with the switched digital video service, and the switched video management server.

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